Republic of Zambia

# PHYSICS
# SENIOR SECONDARY SCHOOL SYLLABUS

**GRADES 10 – 12**

Prepared by:
Curriculum Development Centre
P.O. Box 50092
**LUSAKA**
**2013**

## CONTENTS

**PREFACE**

The review of this Syllabus was necessitated by the need to improve the quality of education at Senior Secondary School Level as stipulated in the national policy document "**Educating Our Future - 1996".**

Quality education raises the standard of living for all. This leads to sustainable national development. The syllabus also addresses issues of national concern such as Environmental Education, Gender and Equity, Health Education and HIV/AIDS, Family Life Education, Human Rights, Democracy, Reproductive Health, Population Education, Entrepreneurship and Vocation Skills, ICT skills Family Life and Values Education.

Another reason for revising this syllabus was to provide linkages with the Junior Secondary School level science which serves to be a prerequisite for senior school science.

It is hoped that this syllabus will provide the users with a sound premise on the basis of which meaningful and effective learning experiences will be developed in order to provide a good foundation for further study of this subject area. It is further hoped that through the study of this syllabus we will be able to produce citizens who are scientifically and technologically literate.

Chishimba Nkonsha
**PERMANENT SECRETARY - EDUCATION**
**MINISTRY OF EDUCATION, SCIENCE, VOCATIONAL TRAINING AND EARLY EDUCATION**
**LUSAKA-ZAMBIA**

**ACKNOWLEDGEMENTS**

The Curriculum Development Centre wishes to pay tribute to the contributors of this Physics Syllabus. The Curriculum Development Centre also wishes to thank the Ministry of Education, Science, Vocational Training and Early Education, for providing the necessary funds, special thanks also go to Japan International Cooperation Agency (JICA) for their technical and financial support particularly in the finalisation of this document and the persons who made the production of this syllabus possible. The institution wishes to express its heartfelt gratitude to individuals and institutions that participated in the production of this syllabus.

**Sakala C. N.M (Mrs.)**
**Director, Standards and Curriculum**
**MINISTRY OF EDUCATION, SCIENCE, VOCATIONAL TRAINING AND EARLY EDUCATION**

## INTRODUCTION

This syllabus has taken into consideration relevant aspects of the 1996 National Policy on Education entitled "Educating Our Future", which demands that the education system should aim at producing a learner capable of appreciating the relationship between scientific thought, action and technology on the one hand, and sustenance of the quality of life on the other. Furthermore, it is part of the policy of the Ministry of Education to improve the teaching and learning of Mathematics and Science in High School.

Another major aspect of this syllabus is that it has taken into consideration environmental issues with emphasis on application of Physics in everyday life.

The syllabus takes into account the fact that the pupils who will follow it will be of different background. Some will study further Physics, some will require the knowledge of this background Physics in pursuing other scientific studies, while some will join the world of work.

## GENERAL AIMS OF THE SYLLABUS

The Syllabus aims at contributing to pupils' general education by using the impact of well-known applications of physics concepts and principles on society. This approach is intended to stimulate pupils' curiosity and sense of enquiry which will in turn not only provide a suitable basis for further study of the subject, but also provide pupils with sufficient knowledge and understanding to make them become useful and confident citizens. The essence of such an enquiry is related to problem solving. This further aims at developing the skills necessary to find solutions to scientific problems.

During this course pupils should acquire the following:

1. Knowledge and understanding of facts, ideas techniques and the applications of Physics.
2. Skill in applying their knowledge and understanding in problem solving.
3. Practical abilities associated with investigation of certain phenomena and principles in Physics.
4. Positive Scientific attitudes such as open mindedness and willingness to recognise alternative points of view.

## GENERAL STRUCTURE OF THE SYLLABUS

The syllabus is divided into units. Every effort has been made to arrange the topics in a logical order but this is not intended to suggest a teaching order. It is hoped teachers will develop a considerable flexibility in planning their presentations.

Each of the Units is described under the headings of "Content", "specific outcomes" knowledge, skills and "values". The column headed "skill" is intended to guide with the type of practical skills to be acquired while value must show what action the learner will take after learning the content and skill and is not to be regarded as exhaustive. The teacher can still extend it by relating the factual contents and specific outcome(s) of the syllabus to social, economic and industrial life at both local and national levels.

In view of the increasing impact of electronics and computers, bipolar transistors and logic gates have been included in the syllabus. It is envisaged that an experimental approach will be adopted and that pupils will spend adequate time on individual experimental work.

## MATHEMATICAL REQUIREMENTS

The study of Physics through this syllabus strengthens the applications of mathematical skills. It is assumed the pupils will be computer in the following mathematical techniques:-

1. Taking account of accuracy in numerical work and handling calculations so that significant figures are neither lost unnecessarily nor carried beyond what is justified.
2. Making approximate evaluation of numerical expressions.
3. Formulating simple algebraic equations as mathematical models from physics situations and be able to solve them.
4. Changing the subject of a formula.
5. Expressing small changes or errors as percentages.
6. Calculating areas of various shapes.
7. Dealing with vectors in all simple forms.
8. Plotting results graphically after selecting appropriate variables and scales.
9. Interpreting, analysing and translating graphical information.

**NOTE:** The list of mathematical abilities above is intended as a guide but is in no way limited nor exhaustive

## ASSESSMENT OF OBJECTIVES

The syllabus will stress:

1. Knowledge and understanding in the following:

    (a) Scientific phenomena, facts, concepts, theories and laws.
    (b) Scientific terminology, use of symbols, quantities and units.
    (c) Scientific apparatus and instruments and their safe operation.
    (d) Scientific and technological applications with social, economic and environmental relevance.

2. Handling information and solving problems including to:

    (a) locate, select, organise and present information from a variety of sources;
    (b) translate information from one form to another;
    (c) manipulate numerical data;
    (d) identify patterns and draw inferences from information;
    (e) give reasonable explanations for patterns and relationships;
    (f) make predictions and hypotheses.

3. Experimental skills including those involving how to:

    (a) follow instructions;
    (b) use techniques, apparatus and materials;
    (c) observe, measure and record;
    (d) plan investigations;
    (e) interpret and evaluate observations and results;
    (f) evaluate methods and suggest possible improvements.

## STRUCTURE OF THE EXAMINATION

The following will be the structure of the examinations.

There will be three (3) question papers as follows:-

| PAPER | TYPE OF PAPER | DURATION | MARKS |
|---|---|---|---|
| 1 | Multiple choice – 40 compulsory items with 60% testing knowledge and comprehension. | 1 hour | 40 |
| 2 | Section A – 8 structured questions<br>Candidates attempt all the questions<br><br>Section B – 4 essay type questions. Candidates attempt 3 of them. | 2 hours | 50<br><br>45 |
| 3 | Practical Examination | 2¼ hours | 30 |

## TIME ALLOCATION

A minimum of six periods of forty minutes each per week, preferably with one (1) double period taken in laboratory for practical work.

## *SCOPE and SEQUENCE*

The following table shows the "Scope and Sequence" of Physics syllabus from G10 to G12.

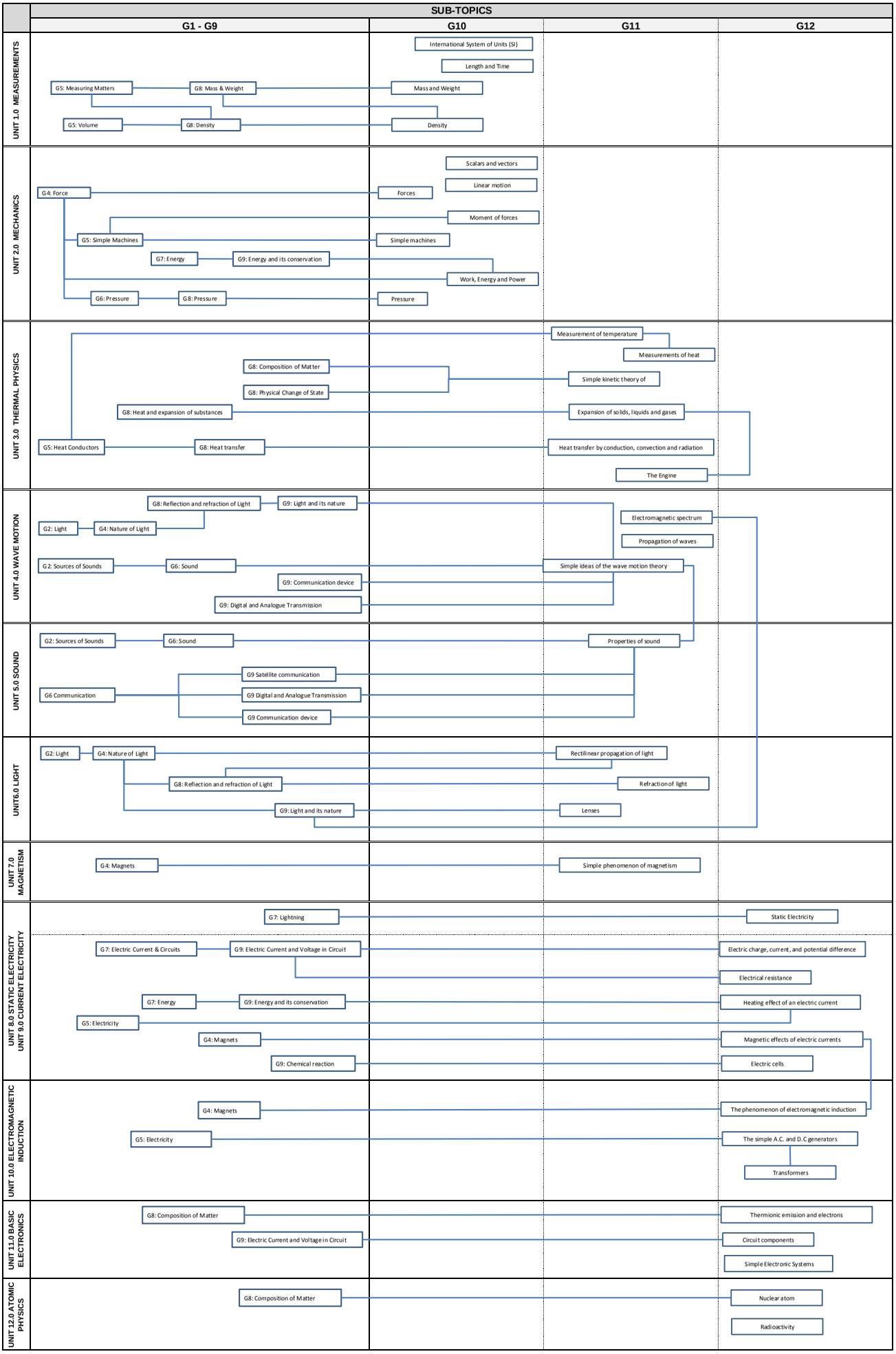
| Grade 10 | | Grade 11 | | Grade 12 | |
|---|---|---|---|---|---|
| **Unit 1 Measurements** | **SUBTOPIC** | **Unit 3 Thermal Physics** | **SUBTOPIC** | **Unit 8 Static electricity** | **SUBTOPIC** |
| | 10.1.1 International System of Units (SI). | | 11.3.1Simple kinetic theory of Matter. | | 12.8.1 Static Electricity |
| | 10.1.2 Length and time | | 11.3.2 Measurement of temperature | **Unit 9 Current electricity** | 12.9.1Electric charge, current, and potential difference. |
| | 10.1.3 Mass and, weight | | 11.3.3 Expansion of solids, liquids and gases. | | 12.9.2 Electric cells. |
| | 10.1.4 Density | | 11.3.4 Heat transfer by conduction, convection and radiation. | | 12.9.3 Electrical resistance |
| **Unit 2 Mechanics** | 10.2.1 Scalars and vectors | | | | 12.9.4 Heating effect of an electric current |
| | 10.2.2 Linear motion | | 11.3.5 Measurements of heat | | 12.9.5 Magnetic effects of electric currents |
| | 10.2.3 Forces | **Unit 4 Wave motion** | 11.4.1 Simple ideas of the wave motion theory. | **Unit 10 Electromagnetic induction** | 12.10.1 The phenomenon of electromagnetic induction |

| | | | | | |
|---|---|---|---|---|---|
| | 10.2.4 Moment of forces | | 11.4.2 Propagation of waves | | 12.10.2 The simple A.C. and D.C. generators |
| | 10.2.5 Work, Energy and Power. | | 11.4.3 Electromagnetic spectrum | | 12.10.3 Transformers |
| | | | | **Unit 11 Basic electronics** | 12.11.1 Thermionic emission and electrons. |
| | 10.2.6 Simple machines | **Unit 5 Sound** | 11.5.1 Properties of sound | | |
| | | **Unit 6 Light** | 11.6.1 Rectilinear propagation of light. | | 12.11.2 Circuit components. |
| | | | 11.6.2 Refraction of light | | 12.11.3 Simple electronic systems |
| | 10.2.7 Pressure | | 11.6.3 Thin converging and diverging lenses. | | 12.11.4 Impact of electronics on society and industry. |
| | | **Unit 7 Magnetism** | 11.7.1 Simple phenomenon of magnetism | **12.12. Atomic physics** | 12.12.1 Nuclear atom |
| | | | | | 12.12.2 Radioactivity |

## *SUBTOPIC-BASED FLOWCHART*

The following chart shows the linkage of each sub-topic from G1 to G12. The relevant sub-topics are connected with solid lines.

# Subtopic-based Flowchart



**TOPICS OF THE SYLLABUS**

# Grade 10

**Key competences**

- Demonstrate ability to measure length, time, mass, weight and volume
- Show skills and knowledge to calculate density, speed, velocity, acceleration and force
- Demonstrate ability to use different sources of energy
- Demonstrate ability to use simple machines to do work

## *UNIT 1.0 MEASUREMENTS*

**General Outcomes:**

- Develop an understanding of measurements
- Develop investigative skills

| TOPIC | SUBTOPIC | SPECIFIC OUTCOMES | CONTENT | | |
|---|---|---|---|---|---|
| | | | KNOWLEDGE | SKILLS | VALUES |
| **10.1 Measurements** | 10.1.1 International System of Units (SI). | 10.1.1.1 Distinguish between basic and derived quantities | • The difference between basic and derived quantities: Basic quantities; mass, length, time etc<br>Derived quantities: force, acceleration, velocity etc | • Comparing basic quantities and derived quantities.<br>• Expressing numbers in scientific notation<br>• Specifying number of significant figures | • Asking questions about physical quantities<br>• Participating in group actively<br>• Applying numbers in standard form |
| | | 10.1.1.2 Identify basic units and derived units. | • Basic and Derived units: Basic units: metre(m), kilogram(Kg), seconds(S) ,Kelvin(K) Derived unit: Newton(N),metre per square second($m/s^2$) | | |

| | | | | | |
|---|---|---|---|---|---|
| | | 10.1.1.3 Recognise prefixes, multiples and submultiples of fundamental and derived units.<br><br>10.1.1.4 Use scientific notation and significant figures in numerical problems. | • Fundamental and derived units: Prefixes, multiples and submultiples of basic and derived units<br><br>• Scientific notation and significant figures | | |
| | 10.1.2 Length and time | 10.1.2.1 Demonstrate the use of various measuring instruments to determine length<br><br>10.1.2.2 Demonstrate the use of clocks and devices for measuring an interval of time<br><br>10.1.2.3 Identify factors that affect the period of a simple pendulum | • Use of measuring instruments: such as rules, vernier calipers and micrometer screw gauge to measure the physical quantity of length<br><br>• Use of devices for measuring time: Using clocks to measure time intervals and period of pendulum<br><br>• A simple pendulum: Factors affecting the period of pendulum such as length and amplitude | • Measuring lengths of different objects<br><br>• Measuring an interval of time using clocks<br><br>• Communicating factors affecting the period of pendulum | • Participating in group actively<br>• Asking questions for more understanding<br>• Applying the use of clocks and devices to determine the period of pendulum |

| | | | | | |
|---|---|---|---|---|---|
| | 10.1.3 Mass and, weight | 10.1.3.1 Distinguish between mass and weight<br><br>10.1.3.2 Demonstrate how to measure mass and weight<br><br>10.1.3.3Demonstrate how to locate the centre of mass of an object<br><br>10.1.3.4 Describe qualitatively the effect of the position of the centre of mass on the stability of an object. | • Differences between mass and weight in terms of units, measuring instrument and quantities<br><br>• Instruments for measuring mass and weight: Using Triple beam balances and spring balances to measure mass and weight<br><br>• How to locate the centre of mass of an object: Use of lamina to locate centre of mass of an object<br><br>• Stability of objects in terms of the position of the centre of mass e.g. equilibrium (stable ,unstable and neutral) | • Comparing mass with weight<br>• Measuring mass and weight of objects<br>• Investigating the centre of mass of objects<br><br>• Communicating conditions for stability of objects, e.g. base, position of centre of mass | • Asking questions for more understanding<br>• Appreciating the use of beam and spring balances<br>• Participating in group actively in locating the centre of mass |

| | | | | | |
|---|---|---|---|---|---|
| | 10.1.4 Density | 10.1.4.1 Determine the density of floating objects<br><br>10.1.4.2 Determine the density of a mixture of liquids<br><br>10.1.4.3 Describe what relative density is<br><br>10.1.4.4 Calculate relative density of air | • Density of floating objects: e.g. cork<br><br>• Density of miscible liquids: e.g. alcohol and water ($\rho=(m_1+m_2)/(v_1+v_2)$)<br><br>• What relative density is: Relative density as ratio without units<br><br>• Calculation of relative density: Use of formula; Relative density of substance (relative density =density of substance/density of water ) | • Calculating the density of a floating object using displacement method<br><br>• Comparing the densities of other objects | • Participating in a group actively<br><br>• Asking questions for more understanding |

## *UNIT 2.0 MECHANICS*

**General Outcomes:**

- Demonstrate an understanding of mechanics
- Develop investigative skills

| TOPIC | SUBTOPIC | SPECIFIC OUTCOMES | CONTENT | | |
|---|---|---|---|---|---|
| | | | KNOWLEDGE | SKILLS | VALUES |
| **10.2 Mechanics** | 10.2.1 Scalars and vectors. | 10.2.1.1 Describe what scalar and vector quantities are | • Scalar and Vector quantities: Quantities; Scalar -size and no direction, vectors - size and direction | • Classifying physical quantities into vectors and scalars | • Participating in a group actively |
| | | 10.2.1.2 Distinguish between scalars and vectors. | • The difference between scalar and vectors: Scalar (distance, mass , time, speed, length, area, volume, temperature, density, work, energy, power), Vectors ( weight, force, acceleration, displacement, velocity, moment) | • Determining magnitudes of resultant vector<br>• Formulating the resultant of two vectors by graphical methods | • Asking questions for more understanding<br>• Appreciating the use of graphical method when adding vectors |
| | | 10.2.1.3 Demonstrate adding of vectors to determine a resultant | • Resultant of vectors: Adding vectors using the formula $F_R = F_1 + F_2$ and $F_R = F_2 - F_1$ | | |
| | | 10.2.1.4 Demonstrate how to determine the resultant of two vectors graphically. | • Resultant of two vectors graphically | | |

| | | | | | |
|---|---|---|---|---|---|
| | 10.2.2 Linear motion | 10.2.2.1 Describe the terms used in mechanics.<br><br>10.2.2.2 Demonstrate the use of equations of uniformly accelerated motion to solve problems<br><br>10.2.2.3 Interpret graphical representation of distance-time, Displacement -time, speed-time, velocity-time and acceleration-time.<br><br>10.2.2.4 Investigate the consequences of over speeding<br><br>10.2.2.5 Describe the acceleration of free fall for a body near the earth. | • Terms used in machines: such as distance, displacement, speed, velocity, acceleration<br><br>• Use of the following equations of motion ($v = u + at$, $s = (v + u)t/_2$, $s = ut + ½ at^2$ $v^2 = u^2 + 2as$)<br><br>• Graphical representation of motion in terms of ; rest, constant speed and constant acceleration<br><br>• Consequences of over speeding e.g. brake failure resulting into car crush<br><br>• Acceleration of free fall for a body near the earth it is constant (approximately $10m/s^2$) | • Comparing distance with displacement; speed with velocity<br>• Classifying appropriate equation (s) of motion to solve particular numerical problems<br>• Plotting and interpreting graphs<br>• Predicting which object in motion would be damaged the most e.g. a slow moving vehicle or a fast moving vehicle , if they hit an obstacle<br>• Calculating acceleration of a body due gravity<br>• Communicating the cause and effect relationship of terminal velocity | • Participating in a group actively<br><br>• Appreciate the use of equations of motion to solve problems<br><br>• Appreciating graphs<br><br>• Appreciating speed limits , road humps, speed traps etc<br><br>• Appreciating the use of parachutes from height |

| | | | | | |
|---|---|---|---|---|---|
| | | 10.2.2.6 Describe qualitatively the motion of bodies falling in a uniform gravitational field with and without air resistance | • The falling motion of bodies in a uniform gravitational field: falling terminal velocity | | |
| | 10.2.3 Forces | 10.2.3.1 Explain what force is.<br><br>10.2.3.2 Explain the effect of forces on bodies.<br><br>10.2.3.3 Describe the inertia law<br><br>10.2.3.4 Demonstrate the relationship between force and acceleration<br><br>10.2.3.5 Demonstrate the relationship between mass and acceleration. | • The definition of force: Force as "Pull" or "push<br>• Effects of forces :change in shape, change in size, change direction, change of motion (acceleration or retardation)<br>• Resistance to change in state of motion (Newton's 1st law)<br>• The relationship between force and acceleration: A constant force produces a constant acceleration<br>• The relationship between mass and acceleration: Increase in mass results in reduction in acceleration (mass is inversely proportional to acceleration for a constant force) | • Communicating the effects of a force using a spring , trolley, Ticker Tape Timer etc<br><br>• Investigating the relationship between mass and acceleration, e.g. higher inertia is due to larger mass<br><br>• Describing the relationship between mass and acceleration<br>• Organising the data of investigation in a table | • Participating in a group actively<br><br>• Appreciating the use of safety belts on vehicles<br><br>• Appreciating Newton's second law of motion<br>• Giving a presentation of group work<br><br>• Knowing the safety rules of investigation |

| | | | | | |
|---|---|---|---|---|---|
| | | 10.2.3.6 Perform calculations on force.<br><br>10.2.3.7 Investigate the effect of force on a spring.<br>10.2.3.8 Demonstrate the effects of friction on the motion of a body.<br><br>10.2.3.9 Describe the motion in a circular path due to a perpendicular force. | • How to calculate force: Using formula; Force = mass ×acceleration<br><br>• Hooke's law (F α e) including graphs.<br><br>• Effects of friction e.g. heat, wear and tear<br><br>• Centripetal force: ($F=m(v^2/r)$) and centrifugal force | • Calculating force, mass and acceleration<br>• Communicating the effects of friction | • Applying the restoration force in devises<br><br>• Participating in class discussion |
| | 10.2.4 Moment of forces. | 10.2.4.1 Perform calculations based on the principle of moments.<br><br>10.2.4.2 Investigate the everyday application of moments. | • Mass, weight and distance of a uniform object e.g. metre rule, metal bar, plank etc based on the principle<br><br>• Application of moments e.g. opening a door or window, opening a bottle with an opener, a see-saw, turning a tap on, tightening a nut with a spanner etc | • Experimenting the principle of moments<br>• Calculating mass ,weight and perpendicular distances | • Participating in a group actively<br><br>• Justifying why handles of certain objects are long. e.g a spanner , wheelbarrow etc |

| | | | | | |
|---|---|---|---|---|---|
| | 10.2.5 Work, Energy and Power. | 10.2.5.1 Explain the meaning of the terms work, energy and power.<br><br>10.2.5.2 Identify the units of measurement for work, energy and power<br><br>10.2.5.3 Calculate work using the appropriate formula<br><br>10.2.5.4 Identify the different forms of energy | • The definition of Work, Energy and Power: Work (force x distance in direction of force)<br>Energy(ability to do work)<br>Power(rate of doing work)<br><br>• The units of work, energy and power : Work(joule), Energy(joule) and Power (watt)<br><br>• The formulae of work:<br>Work = (Force) x (distance moved in the line of action of the force)<br><br>• Different Forms of energy: e.g. mechanical (Kinetic and gravitational potential energy), Chemical, electrical energy etc | • Communicating work, energy and power<br><br>• Communicating the SI units for work, energy and power<br><br>• Calculating work, energy and power using appropriate formulae<br><br>• Analysing different forms of energy and there sources<br><br>• Comparing different forms of energy<br><br>• Communicating renewable and non-renewable resources<br><br>• Observing the effects of energy sources on the environment<br><br>• Demonstrating energy transformations | • Justifying importance of conserving sources of energy<br>• Cooperating in group activities<br><br>• Appreciating the use of clean energy (pollution free energy)<br>• Cooperating in group activities<br><br>• Being aware that some energy sources are non renewable<br><br>• Participating actively in groups<br><br>• Asking questions for more understanding |

| | | | | | |
|---|---|---|---|---|---|
| | | 10.2.5.5 Explain qualitatively and quantitatively the terms gravitational potential and kinetic energy. | • Potential and Kinetic Energy: Gravitational potential energy(energy due to position), Kinetic energy(energy due to motion)<br>**NB**: Gravitational potential energy ($E_P$ = mgh) and kinetic energy ($E_K$ = 1/2mv$^2$ ) | • Describing the law of conservation of energy<br>• Calculating numerical energy problems involving Einstein formula<br>• Calculating efficiency<br>• Calculating power from the formula | • Applying the law of conservation of energy<br>• Appreciating Albert Einstein formula<br>• Applying the formula in determining energy. |
| | | 10.2.5.6 Describe sources of renewable and non renewable energy. | • Renewable and non-renewable energy: Renewable sources of energy: (solar, wind, hydroelectric , geothermal, bio-gas) Non-renewable energy( chemical/fuel, nuclear energy ) | | |
| | | 10.2.5.7 Explain the effects of the use of energy sources on the environment. | • Effects of use of energy sources on the environment: e.g. air pollution, water pollution, deforestation, land degradation etc | | |
| | | 10.2.5.8 Demonstrate energy transformation from one form to another | • Transformation of energy: e.g. chemical energy(Battery) to electric energy (wire)to light energy( bulb) | | |

| | | | | | |
|---|---|---|---|---|---|
| | | 10.2.5.9 Describe the conservation of energy<br><br>10.2.5.10 Calculate energy using mass and velocity<br><br>10.2.5.11Demonstrate the calculation of efficiency of energy conversion using the appropriate formula<br><br>10.2.5.12Demonstrate calculation of power using the appropriate formula | • Principle of conservation of energy<br><br>• Calculation of energy: Using the formula ($E = mc^2$) using the formula to solve numerical problems of energy.<br>• Calculation of efficiency of energy: Using the formula (Efficiency = energy output/ energy input x 100%)<br><br>• Calculation of power: Using the formula ( Power = work done/ time) | | |
| | 10.2.6 Simple machines | 10.2.6.1 Describe what a simple machine is<br><br>10.2.6.2 Identify the different types of simple machines. | • The definition of a simple machine: Enables a large load to be overcome by a small effort<br><br>• Types of simple machines: e.g. Levers, pulleys, gears, inclined planes, wheel and axle | • Communicating types of simple machines<br><br>• Relating the distance moved by the effort to the distance moved by the load at the same | • Cooperating in group activities<br><br>• Listening to other learners with respect<br><br>• Appreciating the use of |

| | | | | | |
|---|---|---|---|---|---|
| | | 10.2.6.3 Describe the distances moved by the effort and the load in a simple machine<br><br>10.2.6.4 Explain the terms of Mechanical advantage (MA), Velocity Ratio (VR) and Efficiency.<br><br>10.2.6.5 Perform calculations involving simple machines | • The relationship between the distance and effort & load in a simple machine: Distance moved by effort and distance moved by the load in the same time<br><br>• The definition of Mechanical advantage (MA), Velocity Ratio (VR) and Efficiency: Mechanical advantage (MA = Load/Effort) Velocity Ratio (VR = distance moved by effort / distance moved by load) Efficiency (; Efficiency = (MA/VR) x 100%)<br><br>• Calculation of MA,VR and efficiency of simple machines | time for a particular type of a simple machine<br><br>• Calculating MA, VR and efficiency of a simple machine | simple machines in doing work e.g bottle opener<br><br>Applying the use the formula to compare MA of different simple machines |
| | 10.2.7 Pressure | 10.2.7.1 Explain what pressure is.<br><br>10.2.7.2 Describe how pressure relate to force and area | • The definition of pressure: Pressure(force/area) Units(pascals, $N/m^2$ ,millibars)<br><br>• The relationship between force and area in pressure and its | • Measuring pressure using barometer , and manometers<br>• Calculating pressure in fluids | • Cooperating in group activities<br><br>• Applying the idea of pressure in our daily life |

| | | | | | |
|---|---|---|---|---|---|
| | | using appropriate examples and formula | formulae: Relating force and area as on when force increases pressure increase and when area increase pressure reduce (calculations using the formula P = F/A) | • Communicating factors affecting pressure in liquids<br>• Describing the transmission of pressure | • Appreciating the use of simple machines in doing work e.g bottle opener |
| | | 10.2.7.3 Identify factors affecting pressure in liquids. | • Factors affecting pressure in liquids: Depth/height and density of the liquid | • Calculating pressure using the formula p= ρgh<br>• Communicating the principle of Archimedes principle | • Appreciating the use the formula to calculate pressure |
| | | 10.2.7.4 Describe the transmission of pressure in hydraulic systems. | • Applications of pressure (Pascal's Law): e.g. hydraulic brakes, hydraulic press and jack | | • Appreciating the use of a barometer and manometer |
| | | 10.2.7.5 Calculate pressure in liquids. | • Calculation of pressure in liquids: Using appropriate formula; "p = ρgh" to calculate pressure in liquids | | • Cooperating in group activities |
| | | 10.2.7.6 Explain the mechanism of a mercury barometer. | • The mechanism of a mercury barometer: Use in determining atmospheric pressure | | • Participating actively in groups |
| | | 10.2.7.7 Explain the mechanism of a manometer | • The mechanism of a manometer: Use in determining gas pressure | | |

| | | | | | |
|---|---|---|---|---|---|
| | | 10.2.7.8 Explain principles of upthrust and floatation.<br><br>10. 2.7.9 Describe how upthrust relate to floatation in fluids. | • Principals of upthrust and floatation in fluids (Archimedes principle)<br><br>• Relationship of upthrust and floatation | | |

# Grade 11

**Key competences**

- Demonstrate ability to show how pressure varies with volume and temperature
- Show skills and knowledge on the construction of thermometers
- Demonstrate ability to show heat transfer in solids ,liquids ,and gases
- Demonstrate ability to show that sound requires a medium for transmission

## *UNIT 3.0 THERMAL PHYSICS*

**General Outcomes:**

- Demonstrate an understanding of thermal physics
- Develop investigative skills

| TOPIC | SUBTOPIC | SPECIFIC OUTCOMES | CONTENT | | |
|---|---|---|---|---|---|
| | | | KNOWLEDGE | SKILLS | VALUES |
| **11.3Thermal physics** | 11.3.1Simple kinetic theory of Matter. | 11.3.1.1 Explain What the kinetic theory is | • The definition of kinetic theory: Matter is made up of discrete individual particles that are continuous in random motion | • Predicting the cause of continuous random motion of the discrete individual particles | • Cooperating in group activities<br>• Being aware of the cohesive and adhesive forces in matter |
| | | 11.3.1.2 Describe qualitatively the molecular model of matter. | • Structure of matter(solid ,liquid ,gases) and intermolecular forces: e.g. cohesive and adhesive | • Interpreting the intermolecular forces i.e. cohesive and adhesive in a much simpler way | • Asking questions for more understanding |
| | | 11.3.1.3. Explain changes of state in terms of the kinetic theory of matter. | • Change of state of matter in relation to kinetic theory | • Experimenting the Brownian motion, diffusion, | • Asking more questions for more understanding |

| | | | | | |
|---|---|---|---|---|---|
| | | 11.3.1.4 Apply kinetic theory to explain rates of diffusion, Brownian motion, evaporation and cooling effect of evaporation.<br><br>11.3.1.5 Apply the kinetic theory to explain gas pressure. | • Use of kinetic theory as in Rate of diffusion, Brownian motion, evaporation and cooling effect of evaporation in terms of kinetic theory<br><br>• Kinetic theory in gas pressure(compressing a gas in a cylinder) | evaporation and cooling.<br>• Collecting the data as experiment<br>• Formulating conclusion of experiment | |
| | 11.3.2Measurement of temperature | 11.3.2.1 Explain what temperature is<br><br>11.3.2.2 Describe physical properties of substances which change with temperature.<br><br>11.3.2.3 Measure the temperature with thermometers<br><br>11.3.2.4 Describe suitability of alcohol and mercury for use in liquid-in-glass thermometers. | • The definition of Temperature: as average kinetic energy of the particles of a substance<br>• Physical properties of substances: such as density, electrical resistance etc of substances<br><br>• Measurement of temperature and Calibration of thermometers<br><br>• Suitability in terms of colour, expansion, conductivity. | • Communicating information on temperature<br>• Experimenting the thermal expansion of matter(liquid, solid, gases)<br><br>• Measuring the temperature<br><br>• Comparing Celsius and Kelvin scale | • Asking questions for more understanding<br>• Cooperating in groups activities<br><br>• Appreciating the use of thermometers in determining temperature<br>• Appreciating the use of thermocouples |

| | | | | | |
|---|---|---|---|---|---|
| | | 11.3.2.5 Describe the relationship between the Celsius and Kelvin scales.<br><br>11.3.2.6 Describe the structure and use of a thermocouple thermometer.<br><br>11.3.2.7 Demonstrate the measurement of temperature using an appropriate thermometer. | • Relation of Celsius and Kelvin scale (K =t + 273)<br><br>• Structure of thermal couple: consisting different metals, two junctions, sensitive galvanometer<br><br>• Appropriate use of thermometers: Liquid in glass thermometers and thermocouple | | |
| | 11.3.3Expansion of solids, liquids and gases. | 11.3.3.1Describe qualitatively the thermal expansion of solids, liquids and gases.<br>11.3.3.2 Explain the effects of expansion of water on aquatic life.<br>11.3.3.3Demonstrate that solids, liquids and gases expand at different rates.<br>11.3.3.4Demonstrate how to determine the boiling and melting point of different substances. | • The thermal expansion of matters: in terms of linear, area and volume expansion<br><br>• Effects of Anomalous expansion of water<br><br>• Different rates of expansions of matter<br><br>• Boiling and melting point of substances: Graphical representation and interpretation | • Experimenting the thermal expansion of solids, liquids and gases<br>• Communicating the effects of expansion on of water on aquatic life during extreme cold seasons.<br>• Experimenting the boiling and melting points of matters<br>• Collecting the data on temperature and time<br>• Organising the data in graphs. | • Appreciating the knowledge about expansion of solids, liquids and gases.<br><br>• Cooperating in group activities<br><br>• Asking questions for more understanding |

| | | | | | |
|---|---|---|---|---|---|
| | | 11.3.3.5Explain effects of pressure on the melting and boiling points.<br><br>11.3.5.6Investigate effects of impurities on the melting and boiling points of substances.<br><br>11.3.3.7 Demonstrate the effect of varying pressure on volume of a gas<br><br>11.3.3.8 Describe the relationship between temperature and volume of a gas<br><br>11.3.3.9 Explain the Kelvin scale from the relationship between temperature and | • Effects of pressure on melting and boiling point of substances: e.g. increase in pressure lowers the melting point) Boiling point(increased pressure increases the boiling point)<br><br>• Effects of impurities on the melting and boiling points of substances: such as Impurities lower the melting point while increase the boiling point of a substance<br><br>• Boils law: use of equation PV=a constant at constant pressure<br><br>• Charles law: as temperature against volume of a gas $V_1/T_1 = V_2/T_2$<br><br>• Kelvin Scale; volume-temperature change (constant pressure ) Graphical extrapolation | • Analyzing the data on graph<br>• Inferring the boiling and melting point of matter<br>• Communicating effects of pressure on melting and boiling points<br>• Investigating the effect of impurities on melting and boiling points<br><br>• Organizing data in the tables to verify the gas laws | • Being aware of the effects of pressure on boiling and melting points<br>• Participating in groups discussion<br><br>• Asking more questions for more understanding<br><br>• Applying the use of graphs to relate variables |

| | | | | | |
|---|---|---|---|---|---|
| | | volume.<br>11.3.3.10 Demonstrate the use of the ideal gas equation to solve simple numerical problems. | • The ideal gas equation ($P_1V_1/T_1=P_2V_2/T_2$) and numerical problems. | | |
| | 11.3.4 The Engine | 11.3.4.1 Explain what an internal combustion engine is.<br><br>11.3.4.2 Identify the different parts of an internal combustion engine.<br><br>11.3.4.3 Describe the operation of the spark plug.<br><br>11.3.4.4 Describe the differe**n**t strokes in a four stroke internal combustion engine<br><br>11.3.4.5 Describe efficiency of a diesel and petrol engine | • The internal Combustion Engine; The ignition of the mixture of liquid fuel and air, inside the cylinder ( Petrol and diesel engine)<br>• Parts of internal combation engine: such as valves, piston, spark plug, cylinder<br>• The operation of Spark plug (produces a spark).<br><br>• The strokes in a four stroke internal combustion engine: Intake, compression, power and exhaust.<br><br>• Efficiency of Diesel engines and petrol engines | • Communicating the operation of an internal combustion engine.<br>• Communicating different parts and different strokes of an internal combustion Engine.<br>• Comparing the most efficient and yet economical engine to use | • Appreciating the use of machines<br>• Asking questions for more understanding<br>• Participating actively in group activities |

| | | | | | |
|---|---|---|---|---|---|
| | 11.3.5 Heat transfer by conduction, convection and radiation. | 11.3.5.1 Explain methods of heat transfer.<br><br>11.3.5.2 Use kinetic theory to explain heat transfer.<br>11.3.5.3 Demonstrate heat conduction in different substances.<br><br>11.3.5.4 Demonstrate the uses of bad and good conductors of heat.<br>11.3.5.5Demonstrate convection in liquids and gases.<br><br>11.3.5.6 Demonstrate the differences between bad and good absorbers of radiant energy<br><br>11.3.5.7 Demonstrate the differences between good and bad heat emitters. | • Heat transfer methods :Conduction, convection and radiation<br>• Relationship between kinetic theory and heat transfer<br>• Heat conduction in different substances<br><br>• Uses of conductors Good conductors; pans, kettle, pots etc; Bad conductors; plastic handles, wooden handles etc<br>• Heat transfer through Convection in fluids<br><br>• Differences between good and bad absorbers of heat: e.g. shiny(white or silver) and dull(black) surfaces<br><br>• Differences between good and bad emitters of heat such as shinning (white or silver) and dull (black surfaces) | • Verifying the methods of heat transfer by experimentation<br><br>• Identifying the relationship between kinetic theory to heat transfer<br>• Communicating uses of bad and good conductors in everyday life<br>• Experimenting good and bad absorbers of radiant heat<br><br>• Observing heat transfer in fluids<br><br>• Inferring good and bad emitters of heat.<br><br>• Investigating the daily applications of the methods of heat transfer | • Participating in group activities during experiments.<br><br>• Being aware of the fact that heat transfer can be explained in terms of kinetic theory.<br><br>• Cooperating in group activities<br><br>• Listening to others with respect<br><br>• Appreciating the knowledge about heat transfer and its application |

| | | | | | |
|---|---|---|---|---|---|
| | | 11.3.5.8 Explain everyday's applications of knowledge on conduction, convection and radiation. | • Application of knowledge on the processes of heat transfer: e.g. thermos flask, electric kettle ,land and sea breeze, green house effect | | |
| | 11.3.6 Measurements of heat. | 11.3.6.1Demonstrate the difference between temperature and heat energy.<br><br>11.3.6.2Describe the terms of heat capacity and specific heat capacity.<br><br>11.3.6.3Identify the SI units of specific heat capacity.<br><br>11.3.6.4Demonstrate how to measure specific heat capacity of solids and liquids. | • Difference between temperature and Heat energy<br><br>• Terms of heat capacity and specific heat capacity: such as Heat capacity(heat to raise temperature by 1K ) Specific heat capacity (quantity of heat which raises the temperature of unit mass by 1K.)<br><br>• SI Units of specific heat capacity: Joules per kilogram Kelvin(J/kg K)<br><br>• Measurement of Specific heat capacity of solids and liquids through Electrical method and methods of mixture | • Comparing between temperature and heat transfer<br>• Communicating heat capacity and specific heat capacity<br>• Communicating the SI units for specific heat capacity<br>• Measuring specific heat capacity of solids and liquids | • Participating in group activities<br><br>• Being aware of the difference between heat capacity and specific heat capacity<br><br>• Cooperating in group activities<br><br>• Appreciating the knowledge about heat capacity |

| | | | | | |
|---|---|---|---|---|---|
| | | 11.3.6.5 Describe the terms latent heat, specific latent heat of fusion and of vaporisation.<br><br>11.3.6.6 Demonstrate the solving of numerical problems on heat measurements | • Scientific Terms: Latent heat; specific latent heat of fusion (melting) and specific latent heat of vaporization<br><br>• Numerical problem on latent heat | • Communicating specific latent heat<br><br>• Calculating numerical problems on heat measurement | • Being aware of latent heat<br><br>• Appreciating the formula used to calculate latent heat |

## *UNIT 4.0 Wave motion*

**General Outcomes:**

- Demonstrate an understanding of wave motion
- Develop investigative skills

| TOPIC | SUBTOPIC | SPECIFIC OUTCOMES | CONTENT | | |
|---|---|---|---|---|---|
| | | | KNOWLEDGE | SKILLS | VALUES |
| **11.4 Wave motion** | 11.4.1 Simple ideas of the wave motion theory. | 11.4.1.1 Demonstrate wave motion.<br><br>11.4.1.2 Distinguish between longitudinal and transverse waves.<br><br>11.4.1.3Describe the terms associated with waves<br><br>11.4.1.4 Apply the wave equation in solving wave motion problems<br><br>11.4.1.5 Explain the use of waves in everyday life. | • Wave motion: e.g. vibrations in ropes, Springs<br>• Different types of wave: Transverse (water and light waves) and Longitudinal (sound waves)in terms of direction of oscillation<br>• Scientific terms: Amplitude (A), period(T),frequency (f), wavelength ($\lambda$) and wave front<br>• The wave equation: Displacement-time and displacement – distance graphs of a wave. (Use the equation $v = f\lambda$.)<br><br>• Use of waves in our life: radio, television, ultrasonic etc. | • Designing experiments to demonstrate wave motion by using ropes, strings<br><br>• Communicating terms associated with waves<br><br>• Calculating numerical problems using the using the formula: "$v = f\lambda$"<br>• communicating knowledge on the daily application of waves | • Asking questions for more understanding<br>• Cooperating in group activities<br><br>• Being aware of the terms associated with wave motion<br><br>• Appreciate the use of the formula to calculate speed the of a wave<br><br>• Participating in group activities |

| | | | | | |
|---|---|---|---|---|---|
| | 11.4.2 Propagation of waves | 11.4.2.1 Explain what propagation, reflection, refraction and diffraction of waves are<br><br>11.4.2.2 Demostrate constructive and destructive interference of waves. | • Scientific terms: Propagation, reflection and refraction of waves. Diffraction of waves using wide, narrow gaps, sharp edges.<br><br>• Two types of Interference of waves: such as Constructive and destructive | • Experimenting the reflection, refraction and propagation of waves using appropriate apparatus.<br><br>• Analysing the wave patterns produced by using barriers having different slit sizes | • Asking questions for more understanding<br><br>• Cooperating in group activities<br><br>• Participating in class discussion actively |
| | 11.4.3 Electromagnetic spectrum | 11.4.3.1 Describe main components of electromagnetic spectrum.<br><br>11.4.3.2 Describe the properties of electromagnetic waves | • Main components of electromagnetic spectrum: such as Gamma, X-rays, ultra violet, visible light, infrared, microwaves and radio waves<br><br>• Properties of electromagnetic waves: e.g. transverse in nature, same speed in vacuum(approximately, c = $3.0 \times 10^8$m/s) etc | • Communicating all components of electromagnetic spectrum<br><br>• Communicating properties of electromagnetic spectrum<br><br>• Analyzing the sources of each of the electromagnetic rays<br><br>• Communicating knowledge on how to detect the rays and their uses | • Being aware of the components of electromagnetic waves and their properties.<br><br>• Appreciating the knowledge about the existence of electromagnetic radiation.<br><br>• Cooperating in group activities |

| | | | | | |
|---|---|---|---|---|---|
| | | 11.4.3.3 Identify the sources of each of the rays in the electromagnetic spectrum.<br><br>11.4.3.4 Describe the method of detection each of the main component of the electromagnetic spectrum.<br><br>11.4.3.5 Explain the use of each of the waves in the electromagnetic radiation spectrum.<br><br>11.4.3.6 Explain the harmful effects of ultra violet radiation, gamma rays and x-rays to life. | • Sources of rays in electromagnetic spectrum: e.g. sun radioactive materials, oscillating electrical circuit etc<br>• The method for detecting electromagnetic radiation<br><br>• Uses of electromagnetic waves<br><br>• Harmful effects of electromagnetic waves e.g. skin cancer etc | • Communicating the uses of electromagnetic waves<br>• Investigating the harmful effects radiation | • Participating in groups actively |

## *UNIT 5.0 SOUND*

**General Outcomes:**

- Demonstrate an understanding of sound
- Develop investigative skills

| TOPIC | SUBTOPIC | SPECIFIC OUTCOMES | CONTENT | | |
|---|---|---|---|---|---|
| | | | KNOWLEDGE | SKILLS | VALUES |
| **11.5 Sound** | 11.5.1 Properties of sound | 11.5.1.1 Explain how sound is produced.<br>11.5.1.2 Describe what rarefactions and compressions are.<br>11.5.1.3 Describe the approximate range of audible frequencies.<br>11.5.1.4 Investigate that sounds requires a medium for transmission.<br>11.5.1.5 Determine the speed of sound in air.<br>11.5.1.6 Describe the relative speed of sound in solid, liquid and gas. | • Production of sound using vibrating objects<br>• Sound wave essentials: rarefactions (stretches) and compressions ("Squash es")<br>• Range of audible sound frequencies (20Hz to 20000Hz)<br>• Effects of sound waves traveling through air and a vacuum<br>• Speed of sound in air (approximately 330m/s)<br>• Respective speeds of sound in solids, liquids and gases | • Experimenting on sound production<br>• Communicating knowledge about wave motion<br>• Designing experiment that sound requires a medium for its propagation through experimentation<br>• Communicating knowledge about the speeds of sound in different medium.<br>• Identifying factors that influence the quality of sound | • Cooperating in group activities<br>• Participating in groups actively<br>• Asking questions for more understanding<br>• Being aware of the fact that sound travels at different speeds in different media<br>• Giving presentation<br>• Listening to others with respect |

| | | | | | |
|---|---|---|---|---|---|
| | | 11.5.1.7 Demonstrate the characteristics of sound waves.<br><br>11.5.1.8 Describe the factors which influence the quality of sound.<br><br>11.5.1.9 Describe what ultrasonic is<br><br>11.5.1.10 Describe the uses of ultrasonic.<br><br>11.5.1.11 State how to minimise sound pollution | • The characteristics of sound waves: Loudness of sound and its amplitude Pitch of sound and its frequency<br>• Factors which influence the quality of sound: such as overtones or wave form of the note<br>• Ultrasonic: as fundamental frequency of Sounds above human hearing range<br>• Uses of ultrasonic: cleaning, quality control, pre-natal scanning etc<br>• Measures to minimize sound pollution: such as sound proof structures | • Communicating the uses of ultrasonic<br>• Investigating measures to minimize sound pollution | |

## *UNIT6.0 Light*

**General Outcomes:**

- Demonstrate an understanding of Light
- Develop investigative skills

| TOPIC | SUBTOPIC | SPECIFIC OUTCOMES | CONTENT | | |
|---|---|---|---|---|---|
| | | | KNOWLEDGE | SKILLS | VALUES |
| **11.6Light** | 11.6.1 Rectilinear propagation of light | 11.6.1.1Describe the rectilinear propagation of light.<br><br>11.6.1.2Investigate the formation of shadows and eclipse.<br><br>11.6.1.3Describe reflection of light.<br><br>11.6.1.4 Investigate the laws of reflection of light | • The nature of light: Straight line propagation of light<br>• Formation of shadows(umbra, penumbra) and eclipses(earth in umbra and penumbra)<br>• Reflection of light on smooth and rough surfaces: as being regular and diffuse<br><br>• Laws of reflection: as angle of incidence = angle of reflection and incident ray, reflected ray and the normal all lie in the same plane. | • Experimenting the nature of light (light travels in a straight line)<br>• Predicting the formation of shadows and eclipse<br><br>• Experimenting the laws of reflection<br><br>• Investigating the characteristics of an image formed by plane mirrors using ray diagrams | • Appreciating the existence of light<br><br>• Cooperating in group activities<br>• Asking questions for more understanding<br>• Giving presentation<br>• Listening to others with respect |

| | | | | | |
|---|---|---|---|---|---|
| | | 11.6.1.5 Demonstrate the formation of images by plane mirrors.<br><br>11.6.1.6 Identify the position of an image using plane mirrors. | • Image in a plane mirror (virtual, laterally inverted ,position, position and size)<br><br>• The position of an image: Construction of ray diagrams | | |
| | 11.6.2 Refraction of light | 11.6.2.1 Describe what refraction of light is<br><br>11.6.2.2 Explain the terms of refraction of light<br><br>11.6.2.3 Verify the laws of refraction of light.<br><br>11.6.2.4 Describe what refractive index is. | • Refraction of light: as Bending of light rays after passing through different media.<br>• Incident ray, refracted ray ,normal ray and emergent ray)<br>• Laws of refraction: as The ratio sin i/sin r is a constant value(snells law) The incident ray ,the normal, and the refracted ray all lie in the same plane<br>• Refractive index: as Measure of bending of light<br><br>• Refractive index of | • Experimenting the refraction of light<br><br>• Collecting data on the laws of refraction<br><br>• Calculating the refractive index<br><br>• Comparing the refractive index to critical angle<br><br>• Communicating the total internal reflection | • Asking questions for more understanding<br><br>• Cooperating in group activities<br><br>• Participating in group activities actively<br><br>• Applying the knowledge of refraction in daily life<br><br>• Appreciating the knowledge on total internal reflection |

| | | | | | |
|---|---|---|---|---|---|
| | | 11.6.2.5 Investigate the refractive index of a glass block.<br><br>11.6.2.6 Calculate refractive index of a substance (*n*) using real and apparent depth.<br><br>11.6.2.7 Explain the term 'critical angle'.<br><br>11.6.2.8 Describe the relationship between critical angle and refractive index.<br><br>11.6.2.9 Explain how total internal reflection occurs.<br><br>11.6.2.10 Explain how total internal reflection is used. | glass<br>• Using of formula, refractive index of "substance = real depth/apparent depth"<br>• Critical angle: as angle of incidence at which the angle of refraction is $90^o$<br>• the relationship between critical angle and refractive index*:* $n = \sin 90^o / \sin c$, Angle of incidence greater than critical angle<br>• Internal reflection: all the light reflected inside the more denser medium<br>• Use of internal reflection: optic fibre for communication | | |

| | | | | | |
|---|---|---|---|---|---|
| | 11.6. 3 Lenses. | 11.6.3.1 Describe different types of lenses.<br><br>11.6.3.2 Explain the action of lenses on beams of light.<br><br>11.6.3.3 Demonstrate how to determine the focal length,<br><br>11.6.3.4 Calculate the power of the converging lens<br><br>11.6.3.5 Demonstrate how to obtain images formed by converging lenses<br><br>11.6.3.6 Describe the uses of lenses in everyday life. | • Types of lenses; Convex (thin converging) and concave (diverging)<br><br>• Types of rays: Converge and diverge rays of light<br><br>• Focal length: NB: use of formula: "1/f = 1/u + 1/v, magnification=v/u"<br>• Power of the lens: (P=1/f)<br><br>• Characteristics of image: in terms of the position, size and nature of images formed by converging lenses.<br>• Use of lens: in correcting defects in vision: short sight-concave lens, long sight-convex lens, LCD, Camera etc. | • Communicating different types of lenses<br><br>• Experimenting to find out what happens to light when passed through lenses.<br><br>• Inferring the focal length<br><br>• Predicting the images formed by converging lenses<br><br>• Investigating the uses of lenses | • Asking questions for more understanding<br><br>• Cooperating in group activities<br><br>• Participating in group activities actively<br><br>• Giving presentation of group activity<br>• Listening to others with respect<br>• Accept responsibility of group work |

## *UNIT 7.0 Magnetism*

**General Outcomes:**

- Demonstrate an understanding of magnetism
- Develop investigative skills

| TOPIC | SUBTOPIC | SPECIFIC OUTCOMES | CONTENT | | |
|---|---|---|---|---|---|
| | | | KNOWLEDGE | SKILLS | VALUES |
| **11.7 Magnetism** | 11.7.1 Simple phenomenon of magnetism. | 11.7.1.1 Describe properties of magnets<br><br>11.7.1.2 Explain the domain theory of magnetism<br><br>11.7.1.3 Demonstrate induced magnetism.<br><br>11.7.1.4 Demonstrate the making of a magnet<br><br>11.7.1.5 Demonstrate the way to destroy a magnet<br><br>11.7.1.6 Demonstrate the | • Fundamental properties of magnet: such as repulsion, attraction direction N-S ,pole, etc<br>• Domain theory of magnetism<br><br>• Induced magnetism: Transfer of magnetic properties without contact<br>• Magnetisation: using stroking and electrical method<br>• Demagnetisation: using methods such as Electrical method, hammering, heating etc<br>• Magnetic field lines: | • Communicating knowledge on magnetism theory<br>• Investigating induced magnetism<br><br>• Experimenting on magnetization and demagnetization<br>• Observing magnetic field lines using a compass and/ or iron filings<br>• Formulating the pattern of magnetic field lines<br><br>• Communicating information on the uses of magnets | • Cooperating in group activities<br><br>• Asking questions for more understanding<br><br>• Participating in group activities actively<br><br>• Applying the use of magnets in everyday life<br><br>• Appreciating the uses of |

| | | | | | |
|---|---|---|---|---|---|
| | | plotting of magnetic field lines.<br><br>11.7.1.7 Distinguish the magnetic properties of iron and steel.<br>11.7.1.8 Explain the use of magnetic screening and magnetic keepers.<br><br>11.7.1.9Describe the uses of magnets. | Use of Magnetic compass to plot field lines.<br>• Magnetic properties of Iron (susceptible) and steel (retentive).<br>• The use of magnetic screening and magnetic keepers : Magnetic screening (shielding equipment) and magnetic keepers.(prevent loss of magnetic strength)<br>• Use of magnets in our life: circuit breakers, speakers ,electromagnets | | magnets |

# Grade 12

**Key competences**

- Demonstrate ability to measure current and voltage
- Show skills and knowledge to dispose cells and battery
- Demonstrate ability to save electricity
- Demonstrate ability to cost use of electricity

## *UNIT 8.0 STATIC ELECTRICITY*

**General Outcomes:**

- Demonstrate an understanding about Static electricity
- Develop investigative skills

| TOPIC | SUBTOPIC | SPECIFIC OUTCOMES | CONTENT | | |
|---|---|---|---|---|---|
| | | | KNOWLEDGE | SKILLS | VALUES |

| | | | | | |
|---|---|---|---|---|---|
| **12.8 Static electricity** | 12.8.1 Static Electricity. | 12.8.1.1 Demonstrate the existence of static charges<br><br>12.8.1.2 Explain how to detect electric charges.<br><br>12.8.1.3 Describe the properties and uses of static charges<br><br>12.8.1.4 Describe the electric charging and discharging of objects.<br><br>12.8.1.5 Explain the relationship between current and static electricity.<br><br>12.8.1.6 Investigate effects of static charges on the environment. | • Existence of static charge: Positive and negative charges (Law of electrostatics)<br>• Detection of charge: charging by contact, testing the sign of charge using gold - leaf electroscope etc<br><br>• Properties and uses of static charges: -Properties; like charges repel, unlike charges attract -Uses: dust precipitators, ink jet printers, photocopiers.<br><br>• Electric charging and discharging of objects.<br><br>• Relationship between current and static electricity in terms of effects as static electricity producers same effect as current electricity.<br><br>• Effects of static charges on an environment: e.g. lightning etc | • Experimenting the existence of charges by rubbing some materials<br>• Detecting charge using an electroscope<br><br>• Communicating properties and uses of static charge<br>• Experimenting charging and discharging of objects<br><br>• Communicating knowledge on the relationship between current and static electricity<br>• Investigating the effects of static charges on the environment e.g. lightning | • Cooperating in group activities<br><br>• Asking questions for more understanding<br><br>• Participating in groups actively<br>• Knowing the safe rules of experiment<br><br>• Being aware of the effects of charges |

## *UNIT 9.0 CURRENT ELECTRICITY*

**General Outcomes:**

- Demonstrate an understanding of Current Electricity
- Develop investigative skills

| TOPIC | SUBTOPIC | SPECIFIC OUTCOMES | CONTENT | | |
|---|---|---|---|---|---|
| | | | KNOWLEDGE | SKILLS | VALUES |
| **12.9 Current electricity** | 12.9.1 Electric charge, current, and potential difference. | 12.9.1.1 Describe the terms associated with electricity<br><br>12.9.1.2 Identify the units of electric charge and current. | • Scientific Terms: such as Electric charge, potential difference and electric current<br>• Units of electric charge and current: as Coulomb and ampere (I =Q/t) | • Measuring an electric current using an ammeter.<br>• Communicating the SI units for voltage<br>• Communicating | • Participating in groups actively<br>• Cooperating in group works<br>• Appreciating the use of electrical appliance |

| | | | | | |
|---|---|---|---|---|---|
| | | 12.9.1.3 Demonstrate how to measure an electric current.<br><br>12.9.1.4 Describe what potential difference is.<br><br>12.9.1.5 Describe what the volt is.<br><br>12.9.1.6 Differentiate between potential difference (PD) and electromotive force (EMF).<br><br>12.9.1.7 Describe the basic concept of EMF.<br><br>12.9.1.8 Demonstrate the measuring of potential difference (PD) | • Measure an electric current in the circuit: Ammeter<br><br>• Potential difference: as energy required to move a unit charge between two points in a circuit<br><br>• Volt: as joules per coulomb<br><br>• Difference between PD and EMF in terms of work done per unit of charge in driving charge in a circuit and through a component<br><br>• The basic concept of EMF<br><br>• Measurement of PD and EMF: Connecting terminals across source of electric | the concept of the energy dissipated<br>• Measuring potential difference using a voltmeter | • Knowing the safe rules of experiment |

| | | | | | |
|---|---|---|---|---|---|
| | | and electromotive force (EMF). | current /conductor | | |
| | 12.9.2 Electric cells. | 12.9.2.1 Describe the structure of primary and secondary cells.<br><br>12.9.2.2 Demonstrate charging and discharging of the accumulator.<br><br>12.9.2.3 Identify methods of disposal of used cells | • Structure of primary and secondary cells: Primary cells(dry cell), Secondary (lead acid accumulator)<br><br>• How to charge and discharge the accumulator: Charging when current is passed a in opposite direction to current supplies, discharging when in use (acid accumulator)<br><br>• Appropriate methods of disposing used cells. | • Communicating the structure of cells<br><br>• Investigating charging and discharging an acid accumulator<br><br>• Communicating appropriate methods of disposing off used cells | • Asking questions for more understanding<br><br>• Cooperating in group activities<br><br>• Participating in group activities actively<br>• Applying the knowledge of disposal of cells in dairy life |
| | 12.9.3 Electrical resistance. | 12.9.3.1 Explain the meaning of the resistance | • Resistance: opposition to the flow of charge | • Measuring the current and potential difference, using | • Asking questions for more understanding |

| | | | | | |
|---|---|---|---|---|---|
| | | 12.9.3.2 Demonstrate how to determine resistance in a simple circuit.<br><br>12.9.3.3 Describe the relationship between current and potential difference in Ohmic and non Ohmic conductors.<br><br>12.9.3.4 Describe what the internal resistance of a cell is.<br><br>12.9.3.5 Calculate the resistance in series and parallel circuits with Ohm's law.<br><br>. | • Value of resistance in series and parallel (use formula $1/R = 1/R_1 + 1/R_2$)<br><br>• Relationship between current and potential difference: (Graph of p.d. against current for Ohmic and non-Ohmic conductors)<br><br>• Internal resistance of a cell<br><br>• Ohm's law in series and parallel circuits. ( R = V/I) | a voltmeter and an ammeter<br>• Collecting data as experiment<br>• Organizing data in tables and their graphs on ohmic and non ohmic conductor<br>• Formulating the patterns in data | • Cooperating in group activities<br><br>• Participating in group activities actively<br>• Knowing the safe rules of experiment |
| | 12.9.4 Heating effect of an | 12.9.4.1 Demonstrate energy transformations | • Conversion of energy from electricity to heat. | • Analysing energy changes from one form to the | • Asking questions for more |

| | | | | | |
|---|---|---|---|---|---|
| | electric current. | in an electric circuit.<br>12.9.4.2 Investigate the heating effect of an electric current.<br>12.9.4.3 Demonstrate how to calculate electrical energy.<br>12.9.4.4 Describe the relationship of voltage, current and power.<br>12.9.4.5 Demonstrate how to calculate the cost of using electrical Energy<br>12.9.4.6 Describe the use of switches, fuses, earthing and the three pin-plugs.<br>12.9.4.7 Explain the need | • Heating effect of an electric current in heating appliances.<br>• Calculations of electrical energy: Use of formula (E= VIt, etc)<br>• The relationship of voltage, current and power: Power = voltage x current(P=VI)<br>• Cost of using electrical energy: use of kWh as a unit of electrical energy<br>• Electrical components: e.g. switches (on /off power), fuses (prevent appliances from damage), and the three pin-plugs (connecting appliance).<br>• Safety | other<br>• Investigating the heating effect of an electric current<br>• Calculating electrical energy using E=VIt<br>• Communicating relationship among power, voltage and current<br>• Calculating the cost of using electrical energy<br>• Communicating the use of some named electrical components<br>• Investigating the safety precautions<br>• Communicating the colouring of insulators<br>• Investigating the | understanding<br>• Cooperating in group activities<br>• Participating in group activities actively<br>• Appreciating the use of electricity at home<br>• Cooperating in group activities<br>• Applying the safety precautions in the use of electricity<br>• Appreciating the use of energy saving bulbs |

| | | | | | |
|---|---|---|---|---|---|
| | | for earthing metal cases and for double Insulation.<br><br>12.9.4.8 Describe the meaning of three wires found in the cable<br><br>12.9.4.9 Describe the domestic electrical wiring system<br><br>12.9.4.10 Describe ways of conserving electrical energy in homes and industry. | precautions (prevent electric shocks, accidents)<br><br>• Three types of Wires: Live (red or brown), earthing (green and yellow) and neutral (blue)<br><br>• Household circuits: such as cooker circuit, ring circuit, lighting circuit<br><br>• Ways of conserving electrical energy: using energy saving bulbs, switch and serve etc. | basic wiring system in a house<br><br>• Communicating ways of conserving energy | |

| | | | | | |
|---|---|---|---|---|---|
| | 12.9.5 Magnetic effects of electric currents. | 12.9.5.1 Explain magnetic field patterns of electric currents.<br><br>12.9.5.2 Describe the applications of the magnetic effect of an electric current.<br><br>12.9.5.3 Explain the behaviour of an electric current in a magnetic field.<br><br>12.9.5.4 Describe the application of a current placed in a magnetic field.<br><br>12.9.5.5 Describe the nature of forces between parallel currents. | • Lines of force (Magnetic flux) : patterns of electric currents<br><br>• Applications of electromagnets: electric bells, relay switches etc<br><br>• The behaviour of an electric current in a magnetic field: Displacement of current carrying wire current or electron beam<br><br>• Applications of current in a magnetic field: e.g. D.C. motors, galvanometers, ammeter etc<br><br>• Nature of forces: attraction and repulsion of forces between parallel currents. | • Experimenting the magnetic field patterns of electric currents<br>• Communicating use of electromagnets<br><br>• Investigating the displacement of a current carrying wire in a field<br><br>• Inferring the attraction and repulsion of forces between parallel currents<br><br>• Investigating the effects of magnetic fields | • Asking questions for more understanding<br><br>• Cooperating in group activities<br><br>• Participating in group activities actively<br>• Asking questions for more understanding<br>• Applying the effects of magnetic field |

| | | | | | |
|---|---|---|---|---|---|
| | | 12.9.5.6 Describe the effect of magnetic fields on human health and environment. | • Effects of magnetic fields: hearing impairment, radar interference in communication,etc | | |

## *UNIT 10.0 ELECTROMAGNETIC INDUCTION*

**General Outcomes:**

- Demonstrate an understanding about electromagnetic induction
- Develop investigative skills

| TOPIC | SUBTOPIC | SPECIFIC OUTCOMES | CONTENT | | |
|---|---|---|---|---|---|
| | | | KNOWLEDGE | SKILLS | VALUES |
| 12.10 Electromagnetic induction | 12.10.1 The phenomenon of electromagnetic induction. | 12.10.1.1 Investigate the phenomenon of electro-magnetic induction.<br><br>12.10.1.2 Describe the factors affecting magnitude and direction of induced EMF.<br><br>12.10.1.3 State the direction of current produced by an induced EMF. | • Electromagnetic induction: (induced EMF / current in a wire moving cutting magnetic flux ) Faraday's law<br>• Factors affecting magnitude and direction of induced EMF: speed of either magnet or coil, strength of magnet, number of turns of a coil<br>• Direction of induced current: Lenz and Fleming right hand law. | • Experimenting the induction of an EMF/current using a magnet, a coil and ammeter<br>• Collecting data<br>• Organising the data in a table<br>• Interpreting the data<br>• Analysing the factors that affect the magnitude of the induced current/EMF<br>• Inferring the direction of induced current with Fleming right hand rule | • Asking questions for more understanding<br>• Cooperating in group activities<br>• Participating in group activities actively<br>• Knowing the safe rules of experiment |
| | 12.10.2 The simple A.C. and D.C. generators. | 12.10.2.1 Describe simple A.C. and D.C. generators. | • Generators: simple A.C. generator (an alternator with slip-rings) and simple D.C. dynamo with a | • Communicating A.C. and D.C. generators<br>• Comparing the | • Asking questions for more understanding |

| | | | | | |
|---|---|---|---|---|---|
| | | 12.10.2.2 Compare the simple A.A. generator with a simple D.C. generator in terms of structure and its nature.<br><br>12.10.2.3 Describe the action of a diode in rectification.<br><br>12.10.2.4 Explain conversion of an A.C. generator to a D.C. generator.<br><br>12.10.2.5 Contrast the current produced by the D.C. generator with that produced from batteries. | commutator<br>• Structure and its nature of simple A.C and D.C generators<br><br>• Action of diodetes: change A.C. to D.C. by allowing current to flow one way<br>• Conversion of A.C. generator to D.C. generator by use of commutator<br><br>• The direction of Current from D.C generator(varies) and from batteries(constant) | structure and nature of an A.C. and D.C. generators<br><br>• Communicating rectification of alternating current using diodes<br><br>• Comparing the direction of current produced by a D.C. generator to the one produced from batteries | • Cooperating in group activities<br><br>• Participating in group activities actively<br>• Appreciating the use of the generators and batteries |
| | 12.10.3 Transformers. | 12.10.3.1 Demonstrate the principles of mutual induction.<br><br>12.10.3.2 Describe the structure and | • Principles of mutual induction: changing current in one coil gives rise to current in the other<br><br>• The structure and operation of iron core | • Designing investigations to verify mutual induction<br><br>• Communicating step up and step down | • Asking questions for more understanding<br><br>• Cooperating in group activities |

| | | | | | |
|---|---|---|---|---|---|
| | | operation of iron core transformers.<br><br>12.10.3.3 Apply the transformer and power equations to solve numerical problems involving ideal transformers<br><br>12.10.3.4 Calculate the efficiency of a transformer given data.<br><br>12.10.3.5 Explain advantages of high alternating potential difference power transmission.<br>12.10.3.6 Describe the implications of underground power transmission compared to overhead lines.<br>12.10.3.7 Describe the effects of improper management of | transformers<br><br>• Equations of transformer and power: using relations<br>$\frac{Vp}{V_s} = \frac{Np}{N_s}$<br>and<br>$Vp\ Ip = V_s\ I_s$<br><br>(ideal transformer)<br><br>• Calculation of efficiency:<br>[ Efficiency = $(V_s\ I_s)/(Vp\ Ip) \times 100\%$]<br><br>• Advantage of high alternating potential difference power transmission: as in reducing power losses in cables.<br>• Environmental and cost implications of underground power transmission<br>• Effects of improper management of Transformers such as overheating, low/high voltage | transformers<br>• Calculating problems relating to the transformers and power using formulae<br><br>• Calculating the efficiency of a transformer<br><br>• Communicating knowledge on the environmental and cost implications of underground power transmission | • Participating in group activities actively<br>• Appreciating the use of the formula<br>• Being aware of the environmental and cost implications of underground power transmission |

| | | | | | |
|---|---|---|---|---|---|
| | | transformers | | | |

## *UNIT 11.0 BASIC ELECTRONICS*

**General Outcomes:**

- Demonstrate an understanding of basic electronics
- Develop investigative skills

| TOPIC | SUBTOPIC | SPECIFIC OUTCOMES | CONTENT | | |
|---|---|---|---|---|---|
| | | | KNOWLEDGE | SKILLS | VALUES |
| **12.11 Basic electronics** | 12.11.1 Thermionic emission and electrons. | 12.11.1.1 Describe What thermionic emission is<br><br>12.11.1.2 Investigate properties of cathode rays<br><br>12.11.1.3 Distinguish between direction of flow of electrons and flow of conventional current.<br><br>12.11.1.4 Describe applications of electron beams. | • Thermionic emission: release of electrons from a heated cathode<br><br>• Properties of cathode rays: e.g. Deflected by electric and magnetic fields, travel in straight in lines etc.<br><br>• Direction of flow of electrons and conventional current<br><br>• Application of electron beams in CRO ,TV set, X-ray machines etc<br><br>• Basic structure and action of CRO: electron gun, Control grid, anode Y-plates ,X-plates, fluorescent | • Investigating properties of cathode rays by using a CRO<br><br>• Comparing the direction of flow of electrons to conventional current<br>• Communicating the devices that make of electron beams in their operation<br>• Investigating the basic structure of a CRO.<br>• Measuring quantities using a CRO | • Asking questions for more understanding<br><br>• Cooperating in group activities<br><br>• Participating in group activities actively<br>• Appreciating the use of the cathode rays in specific devices<br><br>• Being aware of the structure of a CRO<br>• Appreciating the use of a CRO in measuring |

| | | | | | |
|---|---|---|---|---|---|
| | | 12.11.1.5 Describe basic structure and action of cathode-ray oscilloscope.<br><br>12.11.1.6 Describe the uses of cathode-ray oscilloscope. | screen<br>• Uses of CRO: e.g. measuring( peak voltage, time, frequency),TV etc | | some quantities |
| | 12.11.2 Circuit components. | 12.11.2.1 Identify symbols of basic circuit component.<br><br>12.11.2.2 Determine resistor values using standard colour codes.<br><br>12.11.2.3 Describe action of variable potential divider.<br><br>12.11.2.4 Explain the | • Circuit components and its symbols: such as resistors, potentiometers, capacitors, thermistors, light dependent resistors, reed switches and relays switches, light emitting diodes etc<br><br>• Values of resistors recognised from the colour bands<br><br>• Action of variable potential divider<br><br>• Action of thermistor (as semi conductor) and application of thermistor and light dependent resistors (sensitive to temperature changes in light intensity) | • Communicating the basic circuit components<br><br>• Calculating resistance using standard colour codes and values<br><br>• Investigating the variable potential divider<br><br>• Communicating the daily applications of thermistor and light dependent resistors<br>• Experimenting the charging and discharging of a capacitor | • Cooperating in group activities<br><br>• Asking questions for more understanding<br><br>• Participating in group activities actively<br><br>• Appreciating the use of the thermistors and LDRs in devices |

| | | | | | |
|---|---|---|---|---|---|
| | | action and application of thermistor and light dependent resistors.<br><br>12.11.2.5 Investigate the charging and discharging of capacitors.<br><br>12.11.2.6 Describe the role of capacitors in electronic equipments.<br><br>12.11.2.7 Explain how a reed and relay switches work. | • Charging and discharging of capacitors: Charging through a resistor when connected to current flow and discharging through a resistor when not connected to current flow.<br><br>• Role of capacitors in electronic equipments: filter circuits ,delay circuits, smoothening rectified current etc<br><br>• Works of reed switch and relay switches (by attraction of two iron reeds to switch on / off current and relay switch (as an amplifier)<br><br>• Application of reed and relay switch: alarm bells, starter motor, telephone | • Communicating the role played by capacitors in electronic equipments<br><br>• Communicating how reed and relay switches work<br><br>• Comparing the application of reed and relay switches | |

| | | | | | |
|---|---|---|---|---|---|
| | | 12.11.2.8 Describe application of reed switch and reed relay. | | | |
| | 12.11.3 Simple Electronic Systems. | 12.11.3.1 Describe the action of a bipolar transistor.<br><br>12.11.3.2 State the different types of logic gates.<br><br>12.11.3.3 Demonstrate how to derive the truth tables of logic gates.<br><br>12.11.3.4 Describe the use of bistable and astable circuits. | • Action of a bipolar transistor current amplifier: bipolar transistor as used in electronic switches<br><br>• Types of Logic gates: such as NOT ,AND, OR,NAND, NOR<br><br>• How to derive the truth tables of logic gates.<br><br>• The Use of c bistable and astable circuits: ross-coupled logic gates. (bistable) in computers for data storage. Astable as pulse generator and the used in clocks that controls operations in a computer | • Communicating the action of a bipolar transistor<br><br>• Communicating different types of logic gates<br><br>• Investigating truth tables of logic gates using numbers of 0 and 1 in inputs and out puts<br><br>• Communicating the use of cross-coupled logic gates<br>• Investigating to show how a bistable and abistable work | • Asking questions for more understanding<br><br>• Cooperating in group activities<br><br>• Appreciating the use of the truth tables when dealing with logic gates<br><br>• Participating in group activities actively |

## *UNIT 12.0 ATOMIC PHYSICS*

**General Outcomes:**

- Demonstrate an understanding about atomic physics
- Develop investigative skills

| TOPIC | SUBTOPIC | SPECIFIC OUTCOMES | CONTENT | | |
|---|---|---|---|---|---|
| | | | KNOWLEDGE | SKILLS | VALUES |
| **12.12. Atomic physics** | 12.12.1 Nuclear atom | 12.12.1.1 Describe the structure of the atom.<br>12.12.1.2 Describe the composition of the nucleus in terms of protons and neutrons.<br>12.12.1.3 Explain mass number and atomic number. | • Atomic structure (nucleus and electrons)<br>• Composition of the nucleus (protons and neutrons)<br>• Mass number and Atomic number: mass (Nucleon) number, A, and atomic (proton), number, Z. | • Communicating an atomic structure<br>• Communicating knowledge on the existence of protons and neutrons in the nucleus of an atom | • Asking questions for more understanding<br>• Cooperating in group activities |
| | 12.12.2 Radioactivity. | 12.12.2.1 Describe the nature of radioactivity.<br>12.12.2.2 Describe the characteristics of the three kinds of radioactive radiations: alpha, beta and | • Nature of radioactivity (randomness and spontaneity)<br>• Characteristics of three kinds of radioactive radiations: Alpha (**α**), Beta (**β**) and Gamma (***γ***) radiations in terms of penetration, | • Investigating the nature of radioactivity<br>• Investigating radiation using a G.M counter<br>• Understanding the causes and | • Asking questions for more understanding<br>• Cooperating in group activities<br>• Appreciating the use of a GM counter to detect |

| | | | | | |
|---|---|---|---|---|---|
| | | gamma. | ionization, deflection, charge, relative mass and nature of particles) | effects of background radiation | radiation |
| | | 12.12.2.3 Describe methods of detecting radioactive emissions.<br><br>12.12.2.4 Explain the origin and effects of background radiations<br><br>12.12.2.5 Describe what radioactive decay is.<br><br>12.12.2.6 Describe what nuclear fusion and fission is.<br><br>12.12.2.7 Demonstrate how to determine half life of a radioactive material.<br><br>12.12.2.8 Explain uses of radioactive | • Detection of radioactive emissions: by G.M tube, photographic plate, scintillation counter, bubble chamber<br>• Causes of background radiation (cosmic rays, radioactive elements under rocks.)<br>• Radioactive decay as disintegration of nucleus by alpha, beta and gamma emissions.<br><br>• Nuclear fusion and fission: Nuclear fusion as process of joining very light nuclei together and fission as splitting process of nucleus<br><br>• Half life of a radioactive material: Time taken for activity to reduce by half of the original substance (Decay curves)<br><br>• Uses of radioactive | • Comparing nuclear fission to nuclear fusion<br>• Calculating half life of a radioactive material by using decay curves<br>• Communicating the uses of radioactive substances<br>• Communicating knowledge on safety precautions<br>• Investigating management practices which safeguard the environment from radioactive contamination | • Being aware of the existence of background radiation and its effects<br><br>• Appreciating the use decay curves to determine half life<br><br>• Participating in group activities actively<br><br>• Applying safety precautions when dealing with radioactive substances |

| | | | | | |
|---|---|---|---|---|---|
| | | substances.<br><br>12.12.2.9 Describe the safety precautions necessary when handling or storing radioactive substances.<br><br>12.12.2.10. Explain the effects of radioactive substances on the environment and health.<br><br>12.12.2.11. Investigate management practices which safeguard the environment from radioactive contamination. | substances: e.g. medical, industrial, agricultural uses<br><br>• Use of protective materials: such as gloves, gogloes, overalls and lead shields<br><br>• Effect of radioactive substances: such as radiation pollution and health hazards<br><br>• Appropriate management safe guard practices | | |

## PRACTICAL PHYSICS

The importance of practical work in Physics cannot be over emphasized. Practical work develops manipulative skills in the learner and gives the learner the opportunity to experiment the scientific method. Needless to mention practical Physics is essential for this syllabus because:

a) There is need to expose learners to practical applications of Physics.

b) Learners should understand, interpret and apply scientific methods in a variety of ways including the theoretical and practical approaches.

c) The study of Physics should be linked with environmental education requirements by quoting local phenomena in relation to Physics studies.

There are scientific processes and skills to which learners must be exposed. Examples of these are observing, experimenting, classifying, measuring, estimating, calculating, predicting and problem solving. Learners should also be exposed to scientific attitude like accuracy, curiosity and creativity.

## KEY QUANTITIES, SYMBOLS AND UNITS IN PHYSICS.

The pages 38 – 41 comprise the symbols and units which may from time to time be used during the study of Physics.

The candidate is expected to have the knowledge of how to apply the symbols and units in physics.

The list is not exhaustive; therefore the teacher and the learner are expected to discover more as they go through this course.

## LIST OF SUGGESTED APPARATUS AND EQUIPMENT FOR THE SYLLABUS

### 1.0 Measurements and Mechanics

Venier callipers, micrometer screw gauges, measuring cylinders, metre rules, displacement cans, beakers, conical flasks, different masses such as 50g, 100g, 200g, 1kg, ticker tape timers, pipettes, burettes, spring balances, beam balances, capillary tubes and pulleys.

### 2.0 Thermal physics

Mercury barometers, clinical and laboratory thermometer, six's maximum and minimum thermometers, manometers, calorimeter, thermos flasks, thermocouple thermometers and hypsometer.

### 3.0 Light

Plane mirrors, converging and diverging lenses, rectangular and triangular prisms, optical pins, colour discs, colour filters, optical camera, light ray boxes, coloured bulbs, projectors such as slide projectors and film projectors.

### 4.0 Sound

Sonometers, turning forks, stop watches, stop clocks, sources of sound such as guitars and drums.

### 5.0 Magnetism

Bar magnets, horseshoe magnets, iron and steel bars, iron filings and plotting compasses.

**6.0 Wave motion**

Ripple tanks, springs and spiral springs, ropes and strings.

**7.0 Electric current/static electricity**

Ammeters, voltmeters, rheostats, capacitors, connecting wires, lead-acid accumulators, dry cells, resistors, tapping keys, switches, fuses, semi-conductors, semi-conductor diodes, electric bells, resistance wires, ebonite and polythene rods, three-pin-plugs, electric bulbs, switch boards and gold leaf electroscopes.

**8.0 Basic electronics**

Cathode ray tubes, maltese cross tube, resistors, light dependant rays (LDRs), thermistors, diodes, capacitors, transistors, TV sets, radios, electronics teaching kits and computers.

**9.0 Nuclear physics**

Geiger muller tube, time scales, rate metres, cloud chambers, bubble chamber alpha emitting radioactive sources and extra high tension (EHT) power supply unit.

**KEY QUANTITIES, SYMBOLS AND UNITS.**

| **Quantity** | **Symbols** | **Unit** |
|---|---|---|
| mass | m | kg |
| length | l | m |
| time | t | s |
| electric current | I | A |
| thermodynamic temperature | T | K |

| | | |
|---|---|---|
| amount of substance | n | mol |
| distance | d | m |
| displacement | s, x | m |
| area | A | $m^2$ |
| volume | V | $m^3$ |
| density | ρ | $kgm^{-3}$ |
| speed | u, v | $ms^{-1}$ |
| velocity | u, v | $ms^{-1}$ |
| acceleration | a | $ms^{-2}$ |
| acceleration of free-fall | g | $ms^{-2}$ |
| force | F | N |
| weight | W | N |
| momentum | P | Ns |
| work | wW | J |
| energy | E, U, W | J |
| potential energy | Ep | J |
| kinetic energy | Ek | J |
| heat energy | Q | J |
| change of internal-energy | ΔU | J |
| power | P | W |
| pressure | P | Pa |
| torque | T | Nm |
| gravitational constant | G | $Nkg^{-2}ms^2$ |
| period | T | s |
| frequency | f | Hz |
| wave length | λ | m |
| speed of electromagnetic-waves | c | $ms^{-1}$ |

| | | |
|---|---|---|
| Avogadro constant number | $N_A$ | $mol^{-1}$ |
| Celsius temperature | $\theta$ | $^oC$ |
| half - life | $t½$ | s |
| decay constant | $\lambda$ | $s^{-1}$ |
| specific heat capacity | c | $JK^{-1}KG^{-1}$ |
| electromotive force | E | V |
| resistance | R | $\Omega$ |
| resistivity | $\rho$ | $\Omega m$ |

**DATA AND FORMULAE**

| | |
|---|---|
| speed of light in free space | $C = 3.00 \times 10^8\ ms^{-1}$ |
| elementary charge | $e = 1.60 \times 10^{-19}\_^{1}$ coulomb |
| the planck constant | $h = 6.63 \times 10^{-34}\ Js$ |
| molar gas constant | $R = 8.31\ JK^{-1}\ mol^{-1}$ |
| the Avogadro constant | $N_A = 6.02 \times 10^{23}\ mol^{-1}$ |
| gravitational constant | $G = 6.67 \times 10^{-11}\ Nm^2kg^2$ |
| acceleration of free fall | $g = 9.81\ ms^{-2}$ |
| the Boltzmann constant | $k = 1.38 \times 10^{-23}\ JK^{-1}$ |
| uniformly accelerated motion | $s = ut + ½\ at^2$ |
| | or $v^2 = u^2 + 2as$ |
| work done on/by a gas | $W = P\Delta V$ |
| gravitational potential | $E_p = mgh$ |
| Energy in mortion | $E=mc^2$ |

| | |
|---|---|
| refractive index | $n = \frac{\sin i}{\sin r}$ |
| resistors in series | $R = R_1 + R_2 + R_3 + \ ...$ |
| resistors in parallel | $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ..... +$ |
| electric potential | $V = Q/4\pi\varepsilon_o r$ |
| capacitors in series | $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + ....$ |
| capacitors in parallel | $C = C_1 + C_2 + C_3 +$ |
| pressure of an ideal gas | $P = \frac{1}{3}\frac{NMC^3}{V}$ |
| alternating current/voltage | $X = x_o \sin wt$ |
| hydrostatic pressure | $P = \rho gh$ |
| energy of charged capacitor | $w = ½QV$ |
| radio-active decay | $x = x_o \exp(-\lambda t)$ |
| decay constant | $\lambda = \frac{0.693}{t½}$ |